Space Weather Technical Forecast

Issued on Saturday, 28 January 2023 at 00:32 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Slight chance of R1/R2 Radio Blackouts. Slight chance of G1/Minor Storm Days 1, 2 and 4 (28, 29 and 31 Jan). Possible increasing fluence, chance of Active (1e8 integrated pfu) by Day 4.

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Solar activity has been Low over the past 24 hours with the largest flare emanating from an emerging plage region near the southeast limb, producing a C5.3 flare at 27/0748UTC. This leaves eight other sunspot regions on the visible disc. However, all regions are small, weak, magnetically simple and mostly stable. Some minor growth has been seen near centre disc, but these regions remain fairly simple at this time.
No Earth-directed CMEs were detected in available imagery.

Solar Wind / Geomagnetic Activity: The solar wind, as observed at L1 by DSCOVR, has been at elevated levels over the last 24 hours, under the influence of a coronal hole High Speed Stream (HSS). Wind speeds varied between 500-580 km/s. Density was slightly above average. The total IMF, Bt, was mostly weak, but reached moderate levels up to 9nT between 27/0400-0930 UTC. The north-south component, Bz, fluctuated weakly between +/-7nT. The phi angle was mainly positive (away from the Sun). Geomagnetic Activity was Quiet to Unsettled (Kp 0-3).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES-16 has been at background levels throughout. High energy electron flux (greater than 2 MeV) has been at background to moderate levels. The associated 24-hour integrated electron fluence has been on a steady trend well below the Active threshold, with 7.45 e6 integrated pfu observed at 28/0001 UTC.

Four-Day Space Weather Forecast Summary
Solar Activity: Solar activity is expected to be predominantly Low, with a slight chance of isolated Moderate-class flares.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs are currently expected during this period. Earth is under the influence of a positive polarity HSS. Wind speeds are most likely to remain elevated through Day 1 (28 Jan), then show a slow decline in the coming days, perhaps to background levels by Days 3-4 (30-31 Jan). Further negative polarity HSS influence may start to give an increase in wind speeds later on Day 4, but it is more likely to occur after the end of this four day period.
Geomagnetic activity is expected to be Quiet to Unsettled (Kp 1-3), with a declining chance of isolated Active (Kp 4) intervals and just a slight chance of G1/Minor Storms (Kp 5) through Days 1 and 2, perhaps again later on Day 4 if we do see further HSS influence.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux observed by GOES16 is expected to remain at background levels. Electron flux is likely to increase through the period as the HSS wanes. Fluence is also likely to rise, with a chance of reaching Active (1e8 integrated pfu) by Day 4 (31 Jan).

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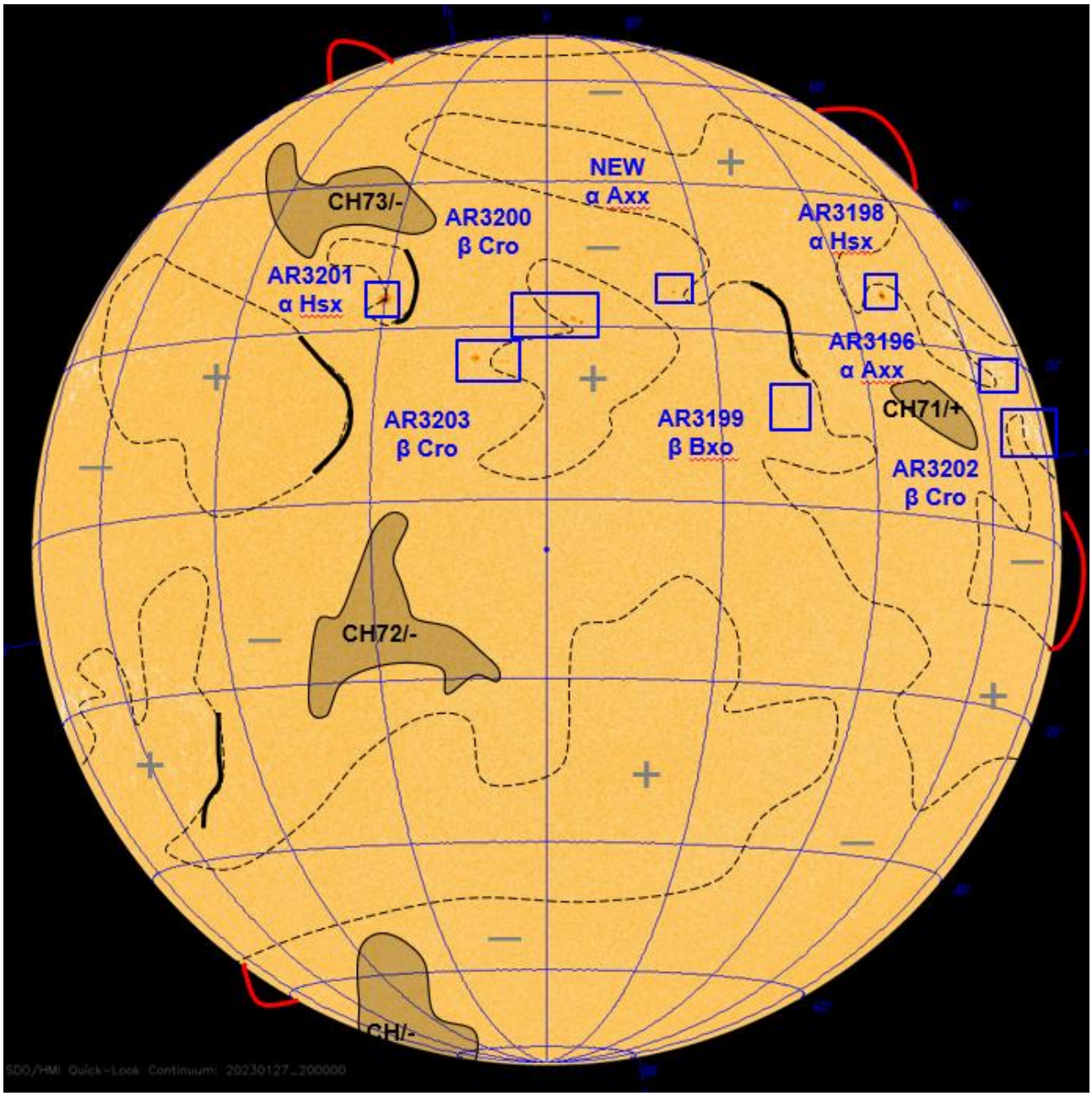
Figure 1. Solar Analysis Valid 27/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

No Earth-directed CMEs are currently expected during this period.

Earth is under the influence of a positive polarity HSS, most likely now from CH71 having probably transitioned from CH69 with a slight uptick in magnetic field in recent hours. However, both are positive polarity coronal holes so it is a little difficult to judge which is which. Wind speeds are most likely to remain elevated through Day 1 (28 Jan), then show a slow decline in the coming days, perhaps to background levels by Days 3-4 (30-31 Jan). The coronal hole is somewhat smaller on this rotation but we are currently following fairly close to persistence. However, wind speeds may decline slightly faster on this rotation as CME effects may have prolonged the higher wind speeds last time around. A further pair of negative coronal holes, CH72 and CH73, may start to give an increase in wind speeds later on Day 4, but it is more likely to occur after the end of this four day period.

Geomagnetic activity is expected to be Quiet to Unsettled (Kp 1-3) for much of the period, with a declining chance of isolated Active (Kp 4) intervals and just a slight chance of G1/Minor Storms (Kp 5) through Days 1 and 2, perhaps again later on Day 4 if we do see further HSS influence.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	5	1	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
*	*	*	*	*	*	*

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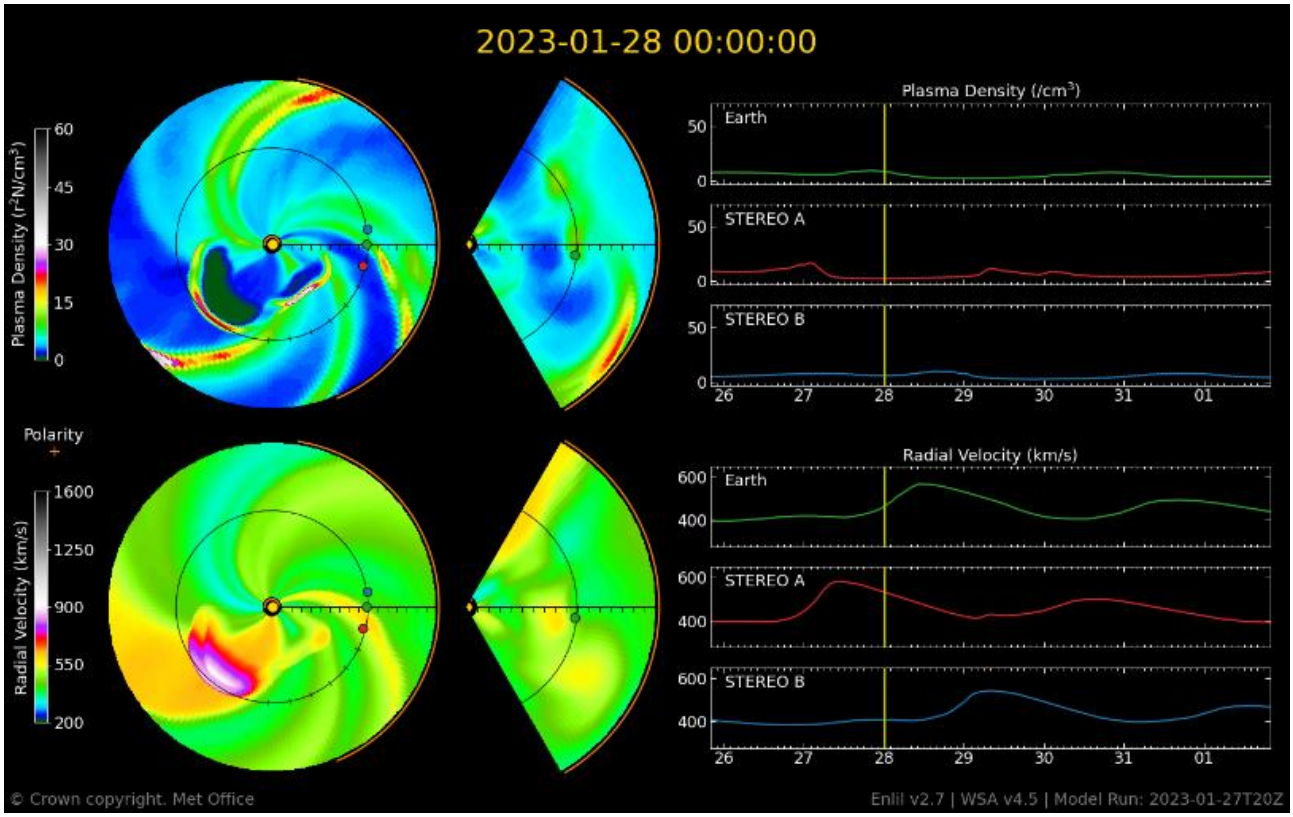
Figure 2: MOSWOC Enlil has been too late to bring in the current HSS. The decline through Days 2 and 3 (29-30 Jan) seems reasonable, but the increase again on 31 Jan may be a little early.



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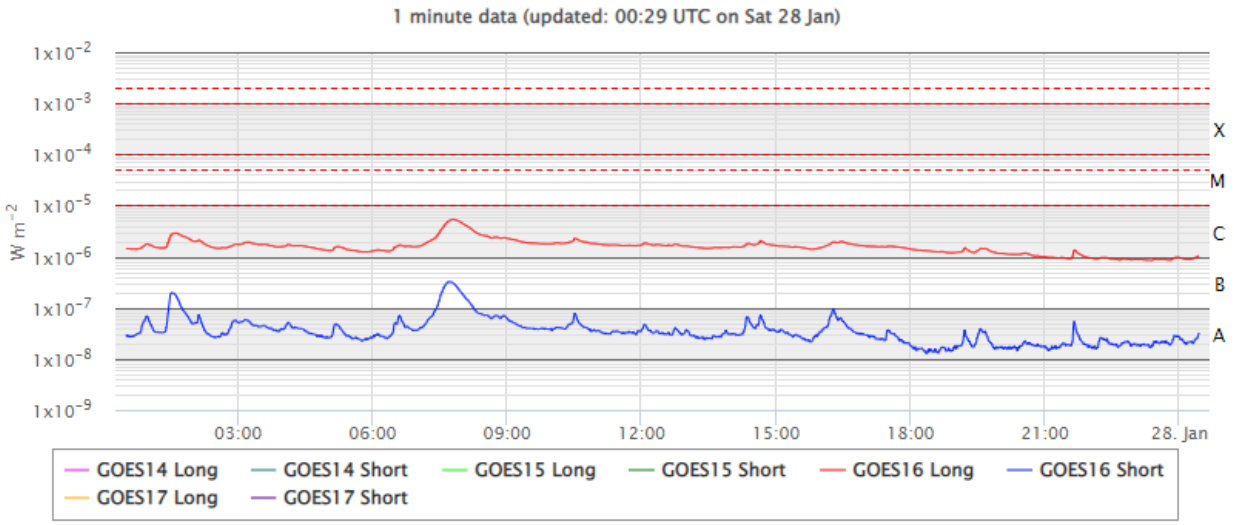
Radio Blackouts - X-Ray Flares:
The sources of the Moderate activity from a couple of days ago, AR3190 and AR3192, are now well over the west limb and any influence from here is rapidly waning. There are now eight sunspot regions on the visible disc, all of which are small and simple. There has been some minor growth near centre disc, but these regions appear unlikely to give significant flares at the present time.

There may be a new region rotating onto the southeast limb, and the largest flare of the last 24 hours (C5.3) came from this area, but it doesn't currently look to be a significant region. As such, solar activity is expected to be Low with a slight chance of isolated M-class flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	15	15	15	15
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: X-ray flare trace from GOES-16. Activity has been Low, with the largest flare originating from near the southeast limb.



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Solar Radiation Storms - (High Energy Protons):
High energy (greater than 10MeV) protons as observed by GOES-16 are currently expected to persist at background levels.

The influence of AR3190, which is now well over the west limb, is rapidly declining. The remaining regions on the visible disc are all small and simple, and therefore unlikely to give any significant increase in proton counts.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	2	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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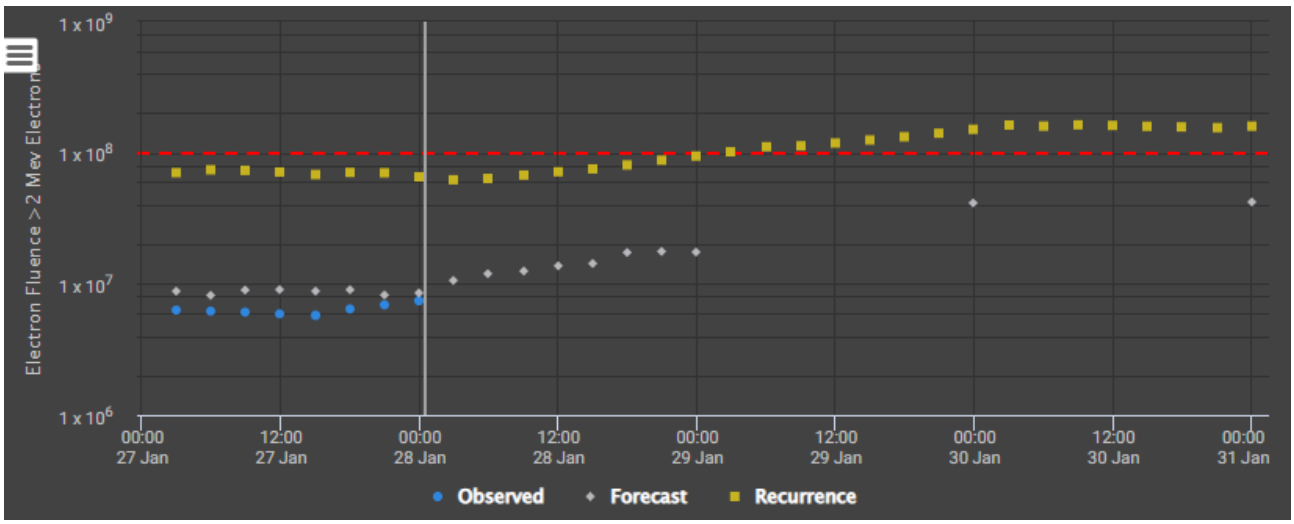
High Energy Electrons Event (≥ 2MeV):
High energy electron flux (greater than 2 MeV) is currently varying diurnally between background and moderate levels. This is likely to increase as the HSS influence wanes and the radiation belts de-compress, although the level of any increase depends on how much charging has taken place during the current fast wind.

The associated 24 hour fluence is likely to show an increasing trend through the period with moderate confidence. There is a chance of reaching the Active (1e8 integrated pfu) threshold, although this is low confidence. REFM is currently forecasting an increase below Active up to Day 3 (30 Jan) which seems reasonable. Fluence did reach above Active on the previous rotation, but electron flux was higher at the equivalent of this point in time previously so levels are expected to be correspondingly lower this time around.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	5	10	20	30
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 4: MOSWOC REFM, showing a forecast rise in fluence but below Active (white spots), which seems reasonable. The previous rotation had higher starting flux, so fluence rose above Active earlier than would be expected this time around. Any such rise is lower confidence on this rotation.



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